A PROPOSED ENERGY EFFICIENT MEDIUM ACCESS CONTROL PROTOCOL FOR WIRELESS SENSOR NETWORKS

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UNIVERSITI UTARA MALAYSIA

2014

A Proposed Energy Efficient Medium Access Control Protocol for Wireless Sensor Networks

A dissertation submitted to Dean of Research and Postgraduate Studies Office

In partial Fulfillment of the requirement for the degree

Master of Science (Information Technology)

Universiti Utara Malaysia

By

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Abstrak

Nod-nod Rangkaian Sensor Tanpa Wayar (WSN) digunakan secara meluas dalam pelbagai sector. Nod-nod ini walaubagaimananpun berdepan dengan pelbagai masalah pengoperasian khususnya pelanggaran paket data, nod terlindung dan lain-lain yang memberikan impak besar ke atas jangka hayat bateri. Nod-nod WSN amat bergantung ke atas jangkahayat baterinya dan penambahan kuasa bateri nod-nod ini adalah sukar kerana nod-nod kerapkali tersusun dalam keadaan *ad-hoc*. Oleh demikian, kuasa bateri dalam nod-nod WSN menjadi factor penting dalam kebolehgunaannya. Satu pendekatan untuk menjimatkan penggunaan kuasa ialah merekabentuk protokol *Medium Access Control* (MAC). Kajian terdahulu telah dijalankan untuk mengatasi masalah yang memberi kesan ke atas jangkahayat bateri. Disertasi ini bertujuan merekabentuk protokol MAC hybrid, Energy Efficient MAC (EE-MAC) untuk mengatasi masalah yang berkaiatan penggunaan kuasa oleh nod-nod WSN. EE-MAC mampu mengurangkan masalah *idle-listening* serta mempercepatkan masa penghantaran data sekaligus menjimatkan kuasa. EE-MAC dibangunkan menggunakan simulator ns-2. Keberkesanan protokol ini disahkan menggunakan model matematik serta dibandingkan dengan piawaian IEEE 802.11 Power Saving Mode (PSM). Simulasi yang dijalankan menunjukkan protokol yang dicadangkan mencapai prestasi yang lebih baik berbanding IEEE 802.11 PSM.

Abstract

Wireless Sensor Network (WSN) nodes are broadly used in various sectors nowadays. WSN nodes experience a lot of problems that impact on battery life for sensor node such as, overhearing, collision, hidden node, idle listening, schedule drifts, and high latency. Moreover, WSN nodes are strongly dependent on its limited battery power, and replenishing it again is difficult as nodes are organized in an ad-hoc manner. Energy consumption is the most vital factor to determine the life of a sensor network because sensor nodes are driven by low battery resources. An approach to conserve energy in WSN nodes is to carefully design its Medium Access Control (MAC) protocol. Several previous work has been carried out to mitigate many problems that impact on battery life for sensor node such as overhearing, collision, and hidden node. This dissertation attempts to design, a hybrid Energy-Efficient MAC (EE-MAC) protocol to address the energy issues that are related to WSN nodes. This protocol aims to reduce idle listening times as well as lowering the latency time thus reducing the energy consumption. The proposed protocol has been developed and analysed using the ns-2 simulator. A mathematical model was used to verify and prove the efficiency of the proposed protocol. We have compared our proposed EE-MAC protocol with the existing contention-based IEEE 802.11 PSM protocol. The simulation results illustrate EE-MAC has achieved better energy conservation than the IEEE 802.11 PSM protocol.

Keywords: EE-MAC, WSN, Medium Access Control, Energy-efficiency, ns-2, IEEE 802.11 PSM.

Acknowledgement

“In the name of Allah the Most Beneficent and Most Merciful”

All praises and thanks to the Almighty, Allah (SWT), who helped me to finish this dissertation. Allah gave me the opportunity, strength and the ability to complete my study for Master degree after a long continuous work. I would like to express my gratitude and special appreciation to my supervisors, Mr. Suwannit Chareen Chit and Dr. Mohd. Hasbullah Omar, who have been tremendous mentor for me. I would like to thank you both for encouraging and advising in both research as well as my career have been priceless.

I sincerely thank my evaluators, Dr. Mohd Nizam Omar and Dr. Shahrudin bin Awang Nor, and thanks to Dr. Norliza Binti Katuk, Dr. Faudziah Binti Ahmad, and other committee members, for graciously reviewing this work and giving me valuable suggestion and comments for my work. I am indebted and thankful to all Malaysian people who are very friendly and make us feel that we are not strangers in Malaysia.

Last but not least, the words cannot express my gratitude to my family, especially my dear father who is my teacher, friend, philosopher all in one who supported me in all ups and downs. My mother for her infallible love and support emotionally, my twin soul dear brother Mohammed Abu-jaafar and my other dear brothers, Ali, Hussain, Abbas, Hassan and sisters. The patience and understanding shown by my wife and my sons Sajjad and Muntadhar during these years is greatly appreciated. Words cannot describe their constant love, care, concern, patience, throughout the two years of my study abroad. I am forever thankful, grateful, and indebted to all of them.

I dedicate the accomplishment of this dissertation to my dear father my affectionate mother, and to the twin of my spirit, my dear brother Mohammed.

"Thank you UUM"

Yasser AL-Rikabi

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Abbreviations

ACK	Acknowledgment
AS-MAC	Asynchronous Scheduled MAC
B-MAC	Berkeley-MAC
CCA	Clear Channel Assessment
CSMA/CD	Carrier Sense Multiple Access/ Collision Detection
CSMA/CA	Carries Sense Multiple Access/Collision Avoidance
DRAND	Distributed Randomized
EB-MAC	Event Based MAC
ECN	Explicit Congestion Notification
EE-MAC	Energy Efficient MAC
HCL	High Contention Level
LCL	Low Contention Level
LPL	Low Power Listening
MAC	Medium Access Control
µOS	Micro Operating System
P-MAC	Pattern-MAC
PSM	Power save Mode
RSS	Received Signal Strength
TDMA	Time Division Multiple Access
WiseMAC	Wireless Sensor MAC
WSN	Wireless Sensor Network
Z-MAC	Zebra-MAC

CHAPTER ONE

INTRODUCTION

1.0 Introduction

Wireless Sensor Network (WSN) nodes are compact-sized, low-power autonomous devices with wireless communication capabilities that are widely used in various real world applications today. Advancement in technology world wide witness applications of WSN nodes in various pace of life, such as military, health care, environmental issues and many more which needs monitoring. These nodes are basically used in various sectors which need close monitoring, hence deployed in a sensor field to measure environmental conditions such as temperature, pressure, humidity, movement, etc. WSN nodes are powered by limited power sources and often exhibit strong dependency on battery life making replenishment an arduous or impossible task as most nodes are positioned in an ad-hoc manner. Energy in WSN node, though often insufficient and limited in supply, is the most important parameter that determines the WSN lifetime. In designing a WSN energy efficiency is required, and the radio is distinguished as a main source of the power consumption in sensor nodes (Jang, Lim, & Sichitiu, 2013).

In WSN operation, energy can be dissipated by either “useful” or “wasteful” means. For example, as a part of useful operation, node requires energy to transmit or receive data messages, and processes query requests through which energy is consumed. On the contrary, energy consumption by means of overhearing, retransmitting due to rough environment, handling with the redundant broadcast overhead messages, as well as idle listening to the media are wasteful energy

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